

Strategic Plan

2021–2025

ORIP

OFFICE OF RESEARCH
INFRASTRUCTURE PROGRAMS



Infrastructure for Innovation



National Institutes of Health
Division of Program Coordination,
Planning, and Strategic Initiatives



Cover Images Captions:

Counter-clockwise from top:
Specific-pathogen-free olive baboon (*Papio anubis*)
Model for SARS-CoV-2, the virus that causes COVID-19
Zebrafish (*Danio rerio*)
Microscope
Rat (*Rattus norvegicus*)
Artistic representation of DNA editing
Center: Depiction of the Vitruvian Human

Inside Cover Caption:

Cryopreservation storage tank

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A detailed 3D rendering of SARS-CoV-2 virus particles. The virus particles are spherical with a textured surface and are covered in numerous red, spike-like protrusions. They are shown in various stages of release from a cluster of blue, textured cells that represent infected tissue. The background is dark, making the blue cells and red spikes stand out prominently.

ORIP contributes to fighting the COVID-19 pandemic.

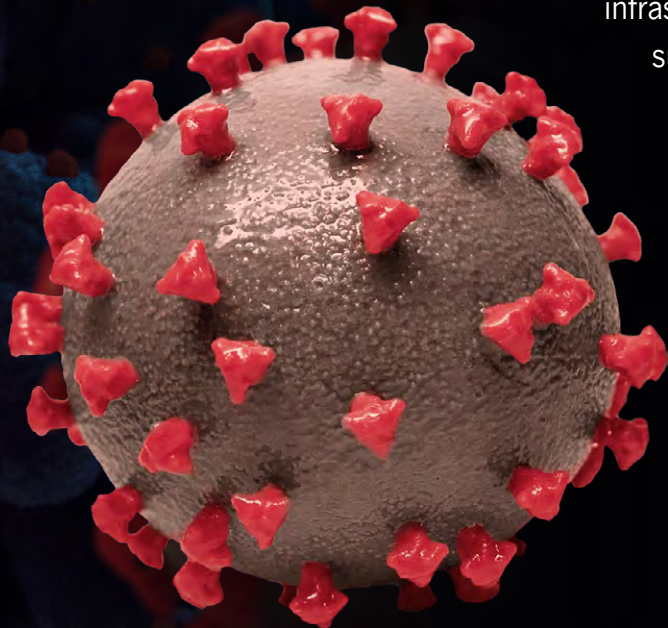
For details, visit
orip.nih.gov/animal-models-and-resources-coronavirus-research

Photo Caption:
Creative depiction of SARS-CoV-2 virus particles being released from infected tissue

From the ORIP Director

As our Office worked on the second Office of Research Infrastructure Programs (ORIP) Strategic Plan in mid-2020, the world was experiencing a global pandemic unmatched in scope and scale for 100 years. This pandemic resulted in a renewed appreciation for the importance of research infrastructure. The speed with which COVID-19 spread around the world meant that we had to fight the virus with our existing research infrastructure, while working to enhance that infrastructure to meet future challenges.

Biomedical research, like other complex human endeavors, benefits from robust and adaptive infrastructure and resources. ORIP supports the National Institutes of Health (NIH) mission by providing a variety of research infrastructure and related programs that benefit researchers supported by many NIH Institutes, Centers, and Offices (ICOs). ORIP also supports specialized biomedical research training for veterinary scientists.



ORIP is part of the NIH Office of the Director (OD), Division of Program Coordination, Planning, and Strategic Initiatives (DPCPSI), which identifies scientific research gaps and emerging opportunities, as well as arising public health challenges. The trans-NIH nature of ORIP activities demands close collaboration among ORIP divisions (Division of Comparative Medicine and Division of Construction and Instruments), DPCPSI, and the entire NIH to optimize infrastructure support of studies for a wide range of diseases across the basic, translational, and clinical research continuum. ORIP collaborates with NIH ICOs to



Photo Caption:
*Franziska Grieder, DVM, PhD,
Director of ORIP*

develop and maintain infrastructure that strengthens their existing programs, advances areas of emerging science, and underpins new initiatives. In partnership with the ICOs, ORIP creates and maintains a variety of resources to advance biomedical research, ranging from animal models and biomaterials, to scientific instruments and equipment, to human expertise. In addition to its many collaborations across the NIH, ORIP strives to form creative collaborations with other federal and nongovernmental entities that have a stake in advancing research infrastructure and resources.

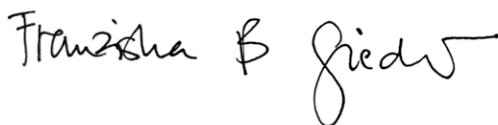
In support of the NIH mission, the ORIP 2021–2025 Strategic Plan provides a framework for strengthening research infrastructure and adapting it to today’s scientific challenges and opportunities. ORIP invests in a diversity of animal models and will promote the comparative study of a wide range of biological models to better understand and improve their value in translational research. ORIP enables construction and maintenance of animal research facilities, including biocontainment facilities, in support of studies using animal models. The COVID-19 pandemic has highlighted the limited capacity of Animal Biosafety Level 3 and 4 facilities, and future efforts will be made to ameliorate this situation. Furthermore, ORIP invests in cutting-edge instrumentation and other technologies and the improvement of resource facilities and their workforces to ensure the highest integrity and productivity of operations.

ORIP recognizes that enhanced resource infrastructure must be accompanied by increased awareness of and access to that infrastructure. This Strategic Plan incorporates new concepts for making research resources broadly and readily available to

the scientific community and for tracking the applications of those resources to research activities. Similarly, the Strategic Plan places emphasis on the development of workshops and conferences to promote the sharing of information and ideas, as well as to fuel transdisciplinary research.

Numerous areas of research across the NIH can benefit from targeted enhancement of the strategic areas supported by ORIP. Enhancing trans-NIH partnerships will, in turn, benefit ORIP's efforts by complementing the expertise available in ORIP. The ORIP 2021–2025 Strategic Plan underscores the importance of sharing information and exchanging ideas across the NIH and the biomedical research community to better understand the infrastructure required to effectively respond to the emerging opportunities and challenges of the next decade.

For ages, libraries have archived the intellectual heritage of scholars for the advancement of knowledge. In a similar way, ORIP-supported centers develop and preserve biological resources that have been—and will continue to be—essential for capitalizing on scientific opportunities and addressing emergent health threats. This Strategic Plan emphasizes ORIP's continued commitment to providing the infrastructure and resources that the scientific community depends upon to respond to an ever-changing landscape of challenges and opportunities in biomedical research.



Franziska B. Grieder, DVM, PhD

ORIP Director

This 5-year plan will enhance biomedical resource infrastructure and support the animal models that are indispensable for understanding the biology of human disease and developing and testing therapies.



Photo Caption:
Veterinary medical student at the National Library of Medicine, NIH

ORIP Mission Statement

ORIP advances the NIH mission to

seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability.

ORIP contributes to this mission by working to

support innovative research ultimately aimed at protecting human health; develop scientists and scientific infrastructure; contribute to the country's economic growth by expanding the biomedical knowledge base; and promote integrity, public accountability, and societal responsibility in scientific research.

Specifically—



ORIP awards grants to support research resources, such as animal models for human disease and cutting-edge biomedical instrumentation.



ORIP plans, organizes, and conducts workshops, both independently and in collaboration with NIH ICOs, to identify and pursue scientific opportunities.



ORIP supports research training opportunities for veterinary scientists to capitalize on their distinct perspective and expertise based on a deep understanding of comparative medicine and insight into animal models for human diseases.

ORIP Statutory Authority and Structure

As a result of the Fiscal Year 2012 Omnibus Appropriations Act, parts of the National Center for Research Resources were transferred to the newly formed ORIP, housed within DPCPSI, NIH OD. ORIP manages the following programs:

Division of Comparative Medicine Programs

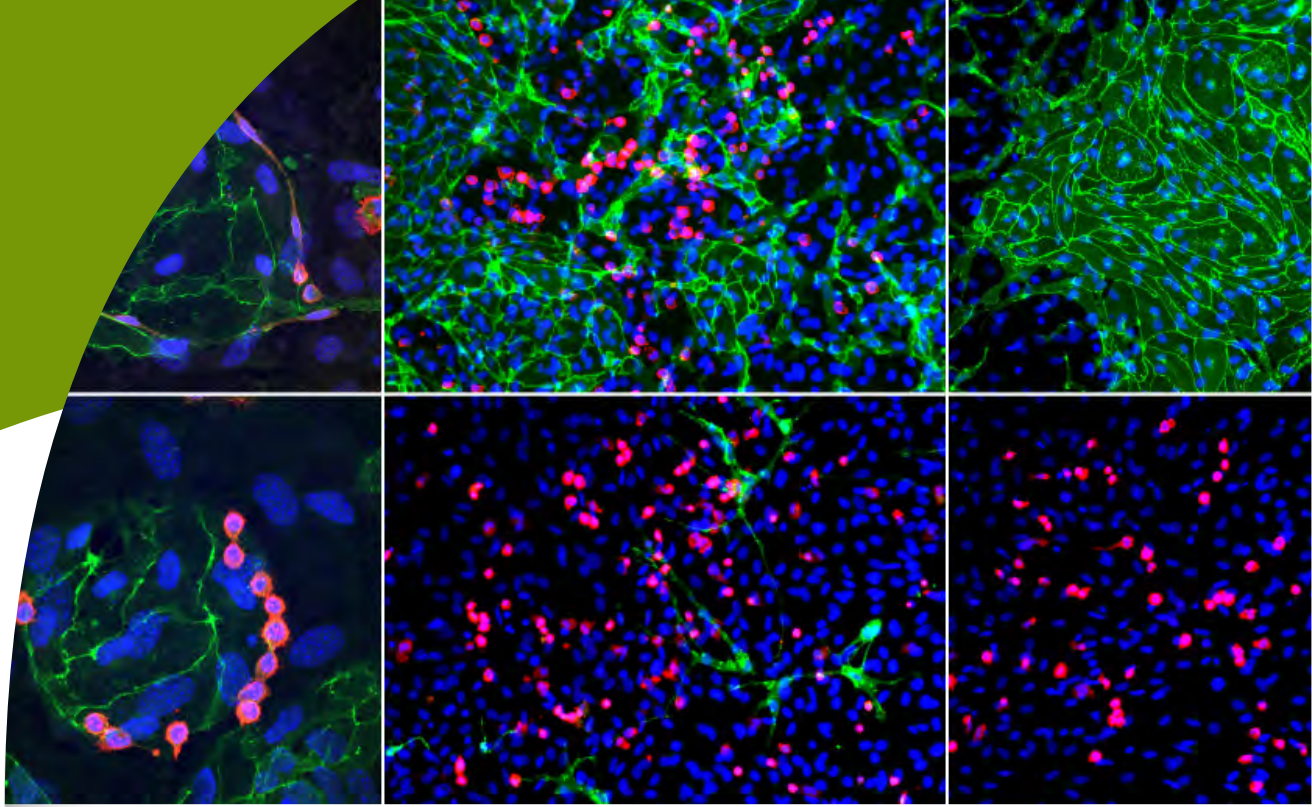
- Nonhuman Primate Resources
- Vertebrate and Invertebrate Animal Resources
- Genetic, Biological, and Other Resources
- Training and Career Development

Division of Construction and Instrumentation Programs

- Extramural Construction
- Research and Animal Facilities Improvement
- Shared Instrumentation

ORIP also participates in the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs by providing grants to support innovation and entrepreneurship in the areas of technology development and commercialization related to improvements in animal models for human disease and the care, use, and management of laboratory animals.

Photo Caption:
Hematopoietic stem cells
from a nonhuman primate



Theme 1

Animal Models to Advance the Study of Human Disease

Animal models and related resources play an essential role in biomedical discovery by enabling scientists to better understand, diagnose, prevent, and treat human diseases. Often serving as a bridge between basic science and human medicine, animal models have enabled numerous major medical advances, such as safe and effective vaccines, blood transfusions, HIV medications, joint replacements, cancer treatments, and bypass surgeries. To study, understand, and treat complex diseases in humans, scientists need a broad array of animal models that mimic the various pathogenic events leading to disease. The value of these models is enhanced by information about their genomic and phenotypic characteristics, which allows researchers to predict human disease outcomes more accurately.

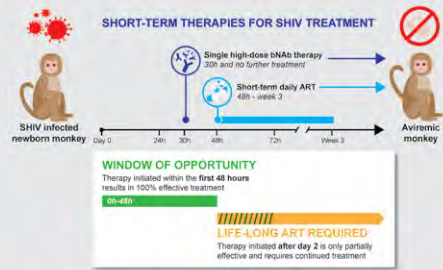
ORIP provides critical infrastructure for biomedical researchers by supporting the development and maintenance of animal models and related resources. ORIP will continue to invest in animal resources that optimize and enhance the scientific rigor, transparency, and experimental reproducibility of biomedical research while ensuring the highest possible level of animal care and model quality. ORIP also will ensure that NIH-supported researchers have access to a wide range of animal models with well-defined genomic and phenotypic data.

Strategy 1.1: Foster development of and provide support for animal models and research-related resources that meet emerging public health needs, prevent disease, promote health, and drive foundational science.

ORIP supports both the development of models for human disease (using animals, cultured cells, and related biological materials) and the infrastructure required to maintain, preserve, distribute, and utilize these models. Examples of supported animal models include rodents, nonhuman primates (NHPs), and other mammalian species; aquatic models, such as fish, frogs, and salamanders; and other species, such as fruit flies and nematodes. ORIP maintains such resources at centers that make these critical disease models readily available to researchers.



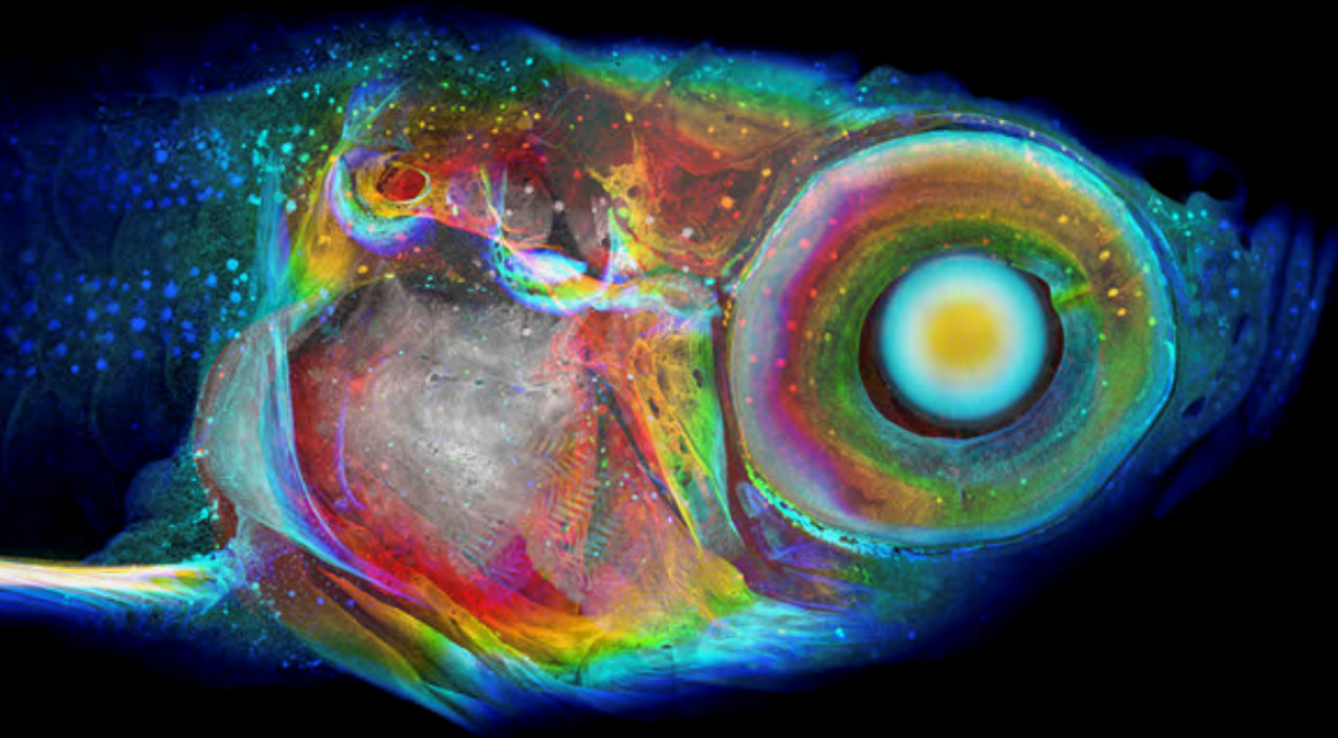
Photo Caption:
Mouse husbandry



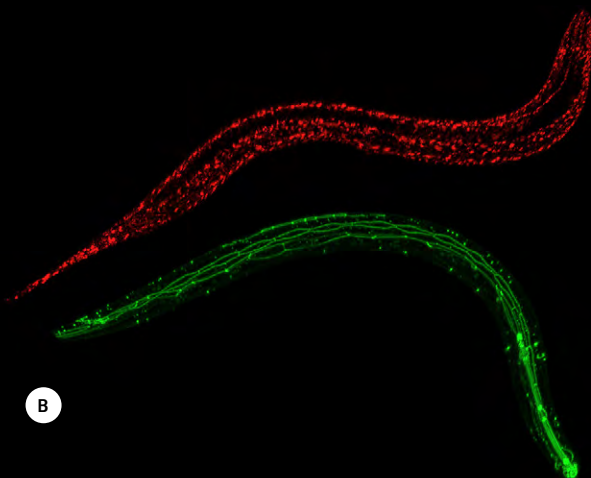
Using a Model to Prevent HIV Infection in Newborns

Simian-human immunodeficiency virus (SHIV) infection can be prevented in newborn rhesus monkeys by a single dose of broadly neutralizing monoclonal antibodies (bNAb) or a short course of antiretroviral therapy (ART) initiated shortly after exposure. This work may guide future therapies for human infants infected with HIV.

[Full story on the ORIP webpage](#)



A



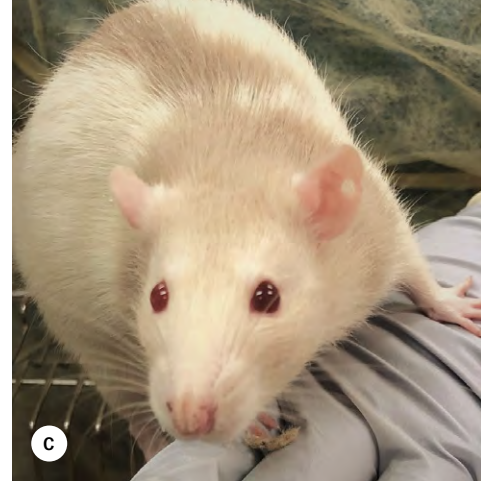
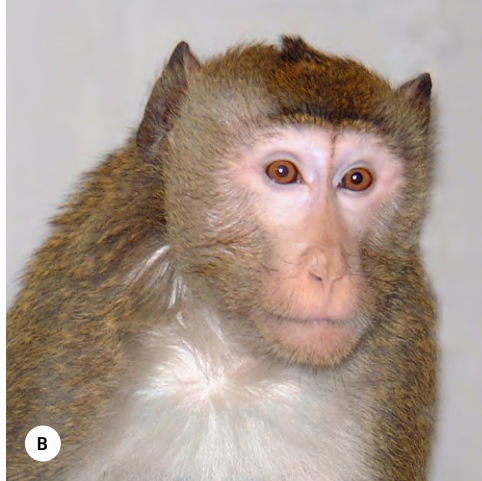
B

Photo Captions:

A: Zebrafish (*Danio rerio*)
imaged using X-ray
histotomography

B: Nematodes (*Caenorhabditis
elegans*) with fluorescently
labeled proteins

Animal models—naturally occurring, induced, and genetically engineered—used to study human disease are increasing in number and complexity. Easier and faster access to these models allows researchers to more quickly generate the data needed to move lifesaving therapies to the clinic.



Animal models—naturally occurring, induced, and genetically engineered—used to study human disease are increasing in number and complexity. Easier and faster access to these models allows researchers to more quickly generate the data needed to move lifesaving therapies to the clinic. New approaches and technologies for creating and assessing animal models and related biomaterials are needed to ensure the effectiveness and enhance the rigor and reproducibility of these important research resources. Assessment of the utility and impact of various animal resources is also necessary to inform decisions regarding the selection of models for specific studies, as well as the decisions to develop and fund specific resources. Broader assessment of emerging research needs and evaluation of programs that support animal resources will help identify resource gaps and opportunities. As new animal resource needs and challenges are identified, new technologies will play an increasingly important role in improving the quality of these resources. To facilitate the development and ensure the availability of the highest quality and most useful animal models and related resources for the advancement of research on human disease, ORIP will—

- **Advance the application of new technologies** to support research resources and improve the generation, care, preservation, and distribution of animal models for the study of human disease, including diseases related to public health emergencies.
- **Make strategic investments** in methods and infrastructure tools to enhance the reproducibility of animal models and research-related resources.
- **Implement program assessments** to identify resource gaps and opportunities.
- **Solicit applications for SBIR/STTR programs** to bring new animal modeling and validation technologies to the biomedical research community.

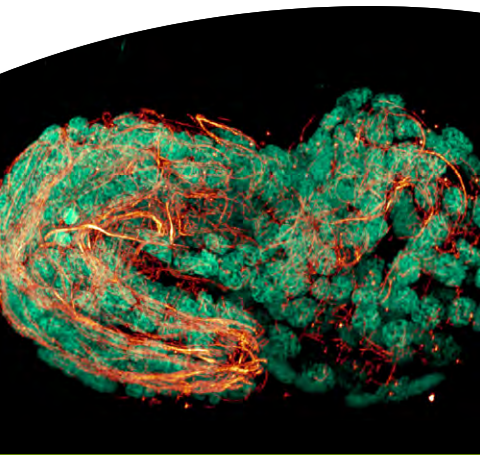
Investments in animal models and related resources are critical for health emergency preparedness and response to new diseases.

Photo Captions:

A: Fruit fly (*Drosophila melanogaster*)

B: *Cynomolgus macaque* (*Macaca fascicularis*)

C: Royal College of Surgeons (RCS) rat model (*Rattus norvegicus*)



Cellular Network in *C. elegans*

WormGUIDES (Worm Global Understanding in Dynamic Embryonic Systems) is an interactive resource that provides dynamic information on the behaviors of individual cells as they assemble into a functional nervous system in a worm embryo (*Caenorhabditis elegans*).

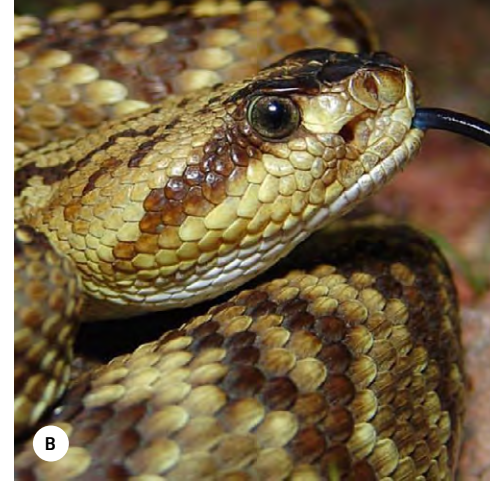
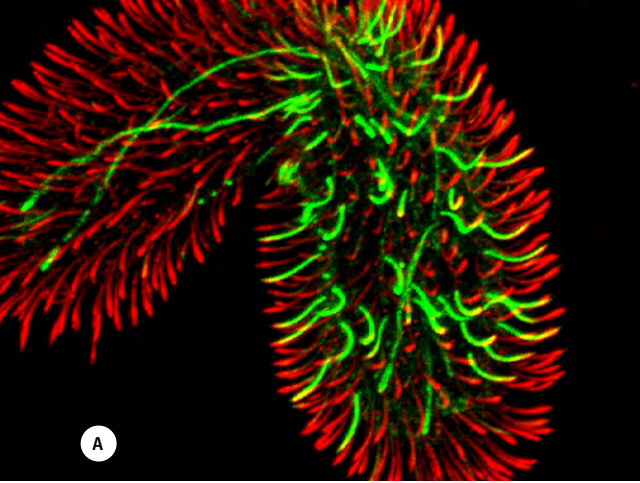
➤ [Full story on the ORIP webpage](#)

Strategy 1.2: Enhance access to a broad range of animal models with robust veterinary care and well-defined genomic and phenotypic data.

ORIP supports a wide variety of translational research projects and resources that develop and enhance access to animal models, including rodent, NHP, aquatic, and invertebrate models. To improve the usefulness of these models, ORIP supports the genomic and phenotypic characterization of animal models and the development of new and improved technologies for the long-term preservation of animal germplasm. ORIP also supports studies aimed at improving the care and husbandry of laboratory animals.

Researchers require access to animal models with well-defined genomic and phenotypic information to understand the biological similarities and differences among models, as well as the mechanisms of human and animal diseases. Robust and consistent veterinary care and full characterization of animal models help improve the reliability and predictive value of these models for studies of human disease, as well as reproducibility across studies. To improve access to well-characterized animal models with greater translatability to human diseases, ORIP will—

- **Support and enhance animal research resources** that are well characterized with genomic and phenotypic data for use by the biomedical research community.
- **Strengthen research capacity and infrastructure** for current and future public health crises, including expansion of Animal Biosafety Level 3 and 4 facilities and the required support spaces at animal model resource centers.
- **Consider the usefulness of nontraditional animal models** for the study of human diseases.
- **Solicit applications for SBIR/STTR programs** to bring new animal care technologies to the biomedical research community.



ORIP supports the genomic and phenotypic characterization of animal models and the development of new and improved technologies for the long-term preservation of animal germplasm.

Photo Captions:

A: *Tetrahymena thermophila*, a ciliated protozoan

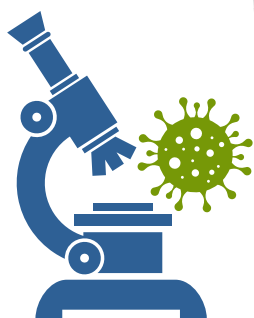
B: Black-tailed rattlesnake (*Crotalus molossus*)

C: Axolotl (*Ambystoma mexicanum*) expressing green fluorescent protein

D: Animal germplasm samples in cryostorage



Photo Caption:
Animal Biosafety
Level 3 laboratory



Theme 2

Innovative Instruments and Equipment to Accelerate Research Discoveries

The availability of new technologies is one key driver of scientific research. Scientific discoveries, in turn, drive the need for novel tools to enable the next generation of innovative research. This interplay of technological advances and scientific discoveries makes access to modern instruments and equipment a critical component of research progress.

ORIP plays a special role for NIH's biomedical research community by supporting programs that provide access to advanced scientific instruments and equipment. Instruments drive research by generating the data behind scientific discoveries. Modern equipment is needed to improve research-supporting functions and

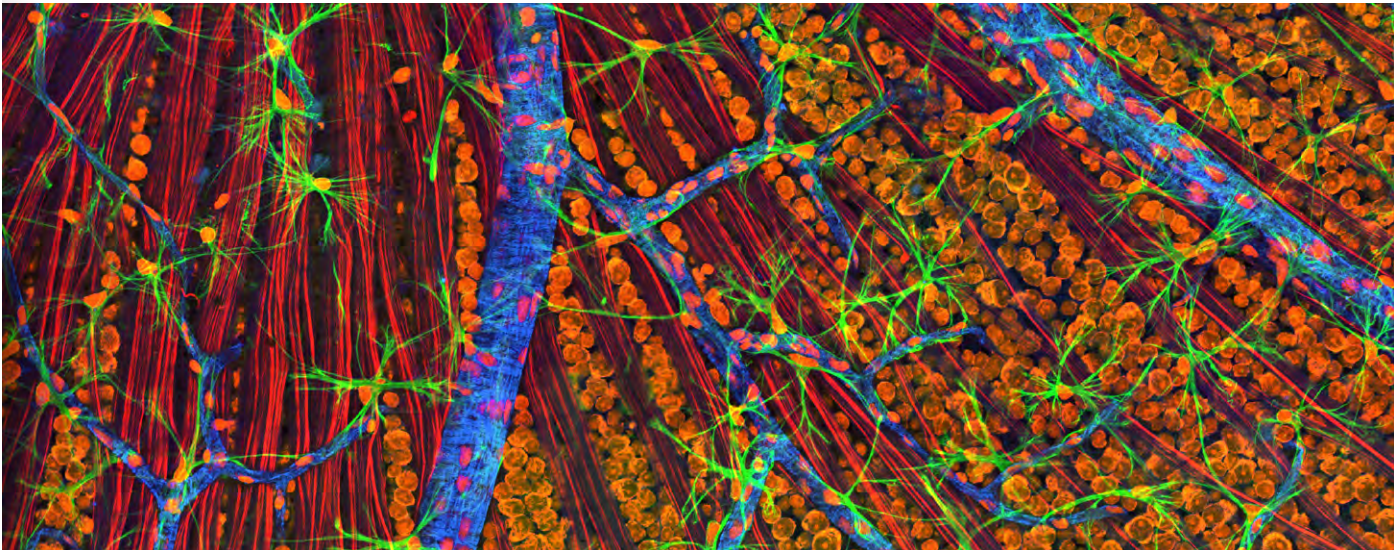


Photo Caption:
Mouse retina imaged with a laser scanning microscope

ensure the efficient operation of laboratories and animal research facilities. Placing equipment and instruments in shared-use facilities ensures broad access and high-quality technical support and creates stimulating scientific environments, magnifying the value of the program.

Building upon its accomplishments and experiences, ORIP will continue to provide funding for advanced scientific instruments and novel laboratory equipment. ORIP will maintain the vitality of its physical infrastructure programs and the essential role they play in advancing biomedical research by continuing to work closely with NIH ICOs and the biomedical research community. Through such ongoing collaborations, ORIP will adapt its programs to optimally meet the changing needs of the research community.

ORIP accelerates research discoveries by providing access to shared scientific instrumentation.

Strategy 2.1: Support acquisition of modern scientific instrumentation.

ORIP supports the Shared Instrumentation Program, which funds grant awards for the acquisition of modern scientific instruments. ORIP-supported instruments are placed in hundreds of research institutions nationwide and benefit thousands of biomedical investigators because each instrument is used on a shared basis. ORIP supports all scientific instrumentation technologies that can be justified by the needs of biomedical research in alignment with the NIH-wide strategic plan.

CryoEM Used to Bridge the Micro–Nano Gap

A Titan Krios cryogenic electron microscope (cryoEM) enables the generation of data at resolutions that rival X-ray crystallography without the need for crystallization. In combination with optical microscopy methods, cryoEM supports multiscale projects linking cell organelles to their macromolecular structures.

[Full story on the ORIP webpage](#)

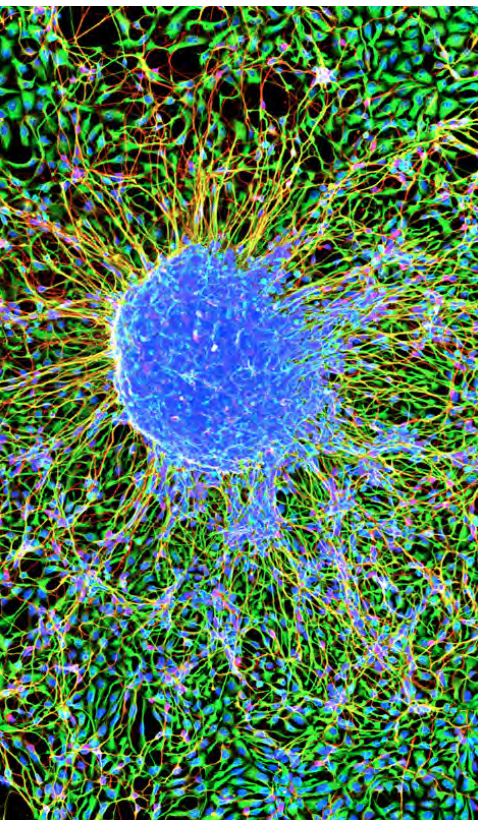
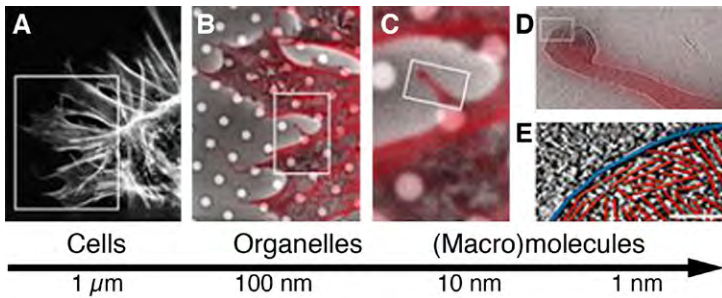


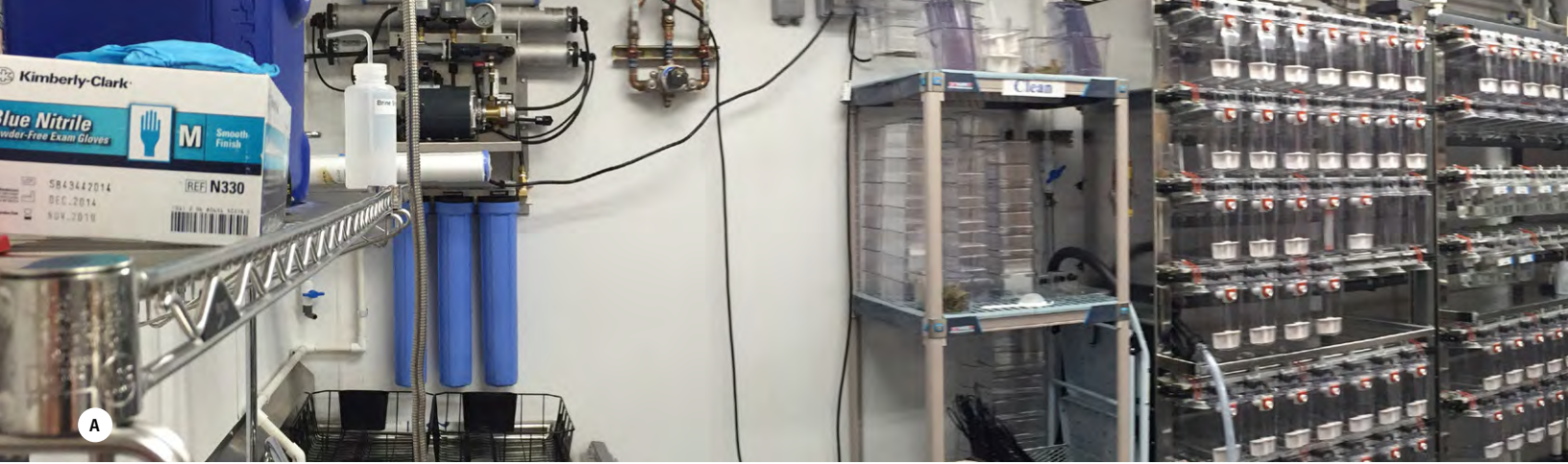
Photo Caption:
Nonhuman primate stem cells
differentiating into neurons

To meet the needs of different scientific fields and different research communities, ORIP supports the implementation of both established technologies and emerging technologies that recently have entered the market. ORIP meets the instrumentation needs of investigators at research-intensive institutions, as well as scientists at institutions with fewer research resources. To ensure continued access to the up-to-date scientific instruments necessary to accelerate biomedical discoveries and advance human health, ORIP will—

- **Facilitate access to a wide range of advanced instruments** fundamental to progress across all disciplines of biomedical research.
- **Respond to evolving instrumentation needs** specific to scientific communities engaged in basic, translational, and clinical research.
- **Address the varying and special modern instrumentation demands** of investigators across a broad spectrum of academic and research institutions.
- **Support emerging novel instrumentation technologies.**



Photo Caption:
Laboratory suite with an FEI Titan Krios™, a state-of-the-art cryogenic electron microscope and imaging robot for research in structural biology



A



B



C

Photo Captions:

A: Zebrafish quarantine room

B: Ionization source of a mass spectrometer

C: 500 MHz nuclear magnetic resonance spectrometer

Strategy 2.2: Modernize the research infrastructure of laboratories and animal research facilities.

ORIP supports the modernization of laboratories and animal research facilities through the installation of equipment and tools designed to improve or streamline operations. Any such modernization project must be located at an institutional animal research facility, a core research facility, or other shared space and must align with the current demands of biomedical research and related activities. ORIP's modernization programs provide the research community with access to high-quality facilities and services.

Every laboratory space or animal research facility employs a broad range of technical solutions to create well-controlled environments and spaces furnished with equipment and tools that enable a broad array of research



and research-related activities. For example, modernized facilities contribute to better habitats for laboratory animals and improve the quality of husbandry, which are essential to the development and maintenance of the well-defined animal models needed for rigorous and reproducible experimental outcomes.

As science progresses, the infrastructure and equipment needs of research laboratories and animal research facilities continue to evolve. To ensure that ORIP's programs meet the changing infrastructure and equipment needs of these laboratories and facilities, ORIP will—

- **Provide advanced laboratory equipment** to improve the operations of research facilities.
- **Promote specialized tools** for animal facility management and animal oversight to drive the development of high-quality models and support robust science.

Photo Captions:

A: Zebrafish quarantine room

B: Scanning electron microscope

C: Bioreactor for growing microorganisms

Photo Caption:
Undergraduate trainee
learning laboratory methods
for molecular biology



Theme 3

Specialized Research Training in Animal Models and Related Resources

Biomedical research training programs must prepare trainees for the full range of skills needed in the biomedical research workforce, in addition to increasing the diversity of that workforce. Expertise in the use of animal models and related resources continues to be essential to the advancement of basic and translational science. Veterinary scientists (biomedical scientists with a veterinary degree) have special expertise that is vital to the use of animal models in research. These veterinary scientists contribute to the biomedical research enterprise by conducting comparative medical research, developing animal models for human disease, and providing critical clinical expertise on research teams working

with laboratory animals. Good science relies on investment in training programs that prepare a diverse biomedical research workforce to use animal models and conduct reproducible research that translates into improved human health.

ORIP invests in multiple career development and training programs designed to increase the expertise and diversity of investigators working with animal resources. ORIP will continue to support innovative programs to train and advance the careers of veterinary scientists engaged in basic and applied research while also providing educational support for individuals from groups historically underrepresented in biomedical research. ORIP will employ a variety of approaches to increase the expertise of researchers and research support staff who are responsible for the oversight and use of animal resources. ORIP also will promote and adapt its training and career advancement programs to help improve scientific expertise and develop a diverse research workforce.

Strategy 3.1: Promote innovative approaches to training and developing the careers of veterinarians working in biomedical research.

ORIP supports programs that recruit highly qualified veterinary students and veterinarians to pursue biomedical research careers. ORIP programs also support the retention and advancement of veterinary scientists who engage in biomedical research. In addition to training support, which includes dedicated time for research, ORIP offers mentorship opportunities for veterinary scientists. These measures increase the expertise of early-career veterinary scientists, enabling them to become independent researchers capable of obtaining grants, engaging in team science, and publishing research findings.

Veterinary scientists promote the highest quality care and welfare of laboratory animals. These scientists also offer a unique perspective through their understanding of comparative biology and their ability



Promoting Diversity within the Biomedical Research Workforce

Corbin Schuster, a member of the Yakama Nation, receives support for his graduate studies at Oregon State University through a Research Supplement to Promote Diversity in Health-Related Research.

➤ [Full story on the ORIP webpage](#)

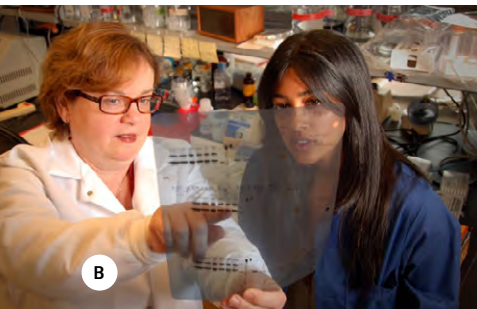


Photo Captions:

A: Research training in the laboratory of Ted Golos, PhD, University of Wisconsin–Madison School of Veterinary Medicine

B: Research training in comparative medicine

C: Cornell College of Veterinary Medicine Leadership Program

to assess the value of various animal models and related resources for the study of specific diseases. Veterinary scientists can make unique recommendations regarding the development, refinement, maintenance, and reproducibility of animal models for human diseases. These scientists also play an increasingly important role in public health, as a growing number of human diseases originate at the intersection of human and animal populations in changing environments. Many veterinary scientists, however, encounter barriers to entry and advancement in the field of biomedical research. To help overcome these barriers and ensure quality training of these essential scientists in new and emerging research areas, ORIP will—

- **Invest in training and mentorship innovations** for the development of veterinary scientists as independent researchers and collaborative team scientists.
- **Support career development and training** that prepares graduate veterinarians to pursue research that fills major gaps in biomedical and biobehavioral science and expands knowledge in emerging areas critical to human health.

Strategy 3.2: Support training and career development programs that promote diversity in health-related research.

ORIP seeks to enhance the diversity of the health-related research workforce through its programs that support training in the management, use, and care of animal models and related resources. ORIP offers targeted funding to recruit and train students, postdoctoral trainees, and eligible investigators from population groups historically underrepresented in the biomedical, behavioral, and clinical research workforce to work on research projects involving animal resources.

Fostering diversity in the scientific research workforce is a key component of NIH's strategy to identify, develop, support, and maintain the quality of the biomedical research workforce. Ensuring that the United States remains a global leader in scientific discovery and innovation depends on a pool of highly talented scientists from diverse backgrounds, including those from underrepresented groups. Diverse teams that work together to capitalize on innovative ideas and distinct perspectives outperform homogenous teams. To ensure that scientists and trainees from diverse backgrounds and life experiences continue to contribute their unique talents and perspectives to biomedical research efforts that use animal resources, ORIP will—

- **Encourage and sustain the training and development** of the next generation of a diverse and interdisciplinary community of scientists.
- **Invest in students, postdoctoral researchers, and eligible investigators** from groups historically underrepresented in health-related research.

ORIP's programs to train the next generation of veterinary scientists and other biomedical research staff who work with animal models provide a unique contribution to NIH's mission.

Photo Caption:

Veterinary Summer Scholars Program at the University of Georgia College of Veterinary Medicine





Photo Captions:

A: Students seeking novel fish viruses with Tony Goldberg, DVM, PhD

B: Participant in an ORIP-sponsored veterinary medicine summer scholars program

C: Trainee's final presentation for an ORIP-sponsored veterinary medicine leadership program

Strategy 3.3: Promote career development of researchers and support staff skilled in the use and oversight of disease model and research resources.

ORIP supports technical training in the use of model organisms and related resources. Critical support for other investigators interested in biomedical research careers involving the use of animal models and related resources is provided by the ORIP-supported animal resource centers. Furthermore, in collaboration with other NIH ICOs, ORIP supports workshops and other targeted events designed to educate biomedical researchers about the use of specific animal models and related resources in emerging research areas, such as precision medicine.



The ongoing training of the biomedical research workforce is necessary to ensure that investigators fully understand the advantages and limitations of the range of animal resources, as well as the appropriate and humane management, care, and handling of laboratory animals. Such training promotes both animal welfare and reproducibility of research findings. As part of its evolving training and career development efforts, ORIP will—

- **Maintain the highest integrity of animal resource training and operations.**
- **Expand and promote available resource-related training and expertise at ORIP-supported centers and programs.**

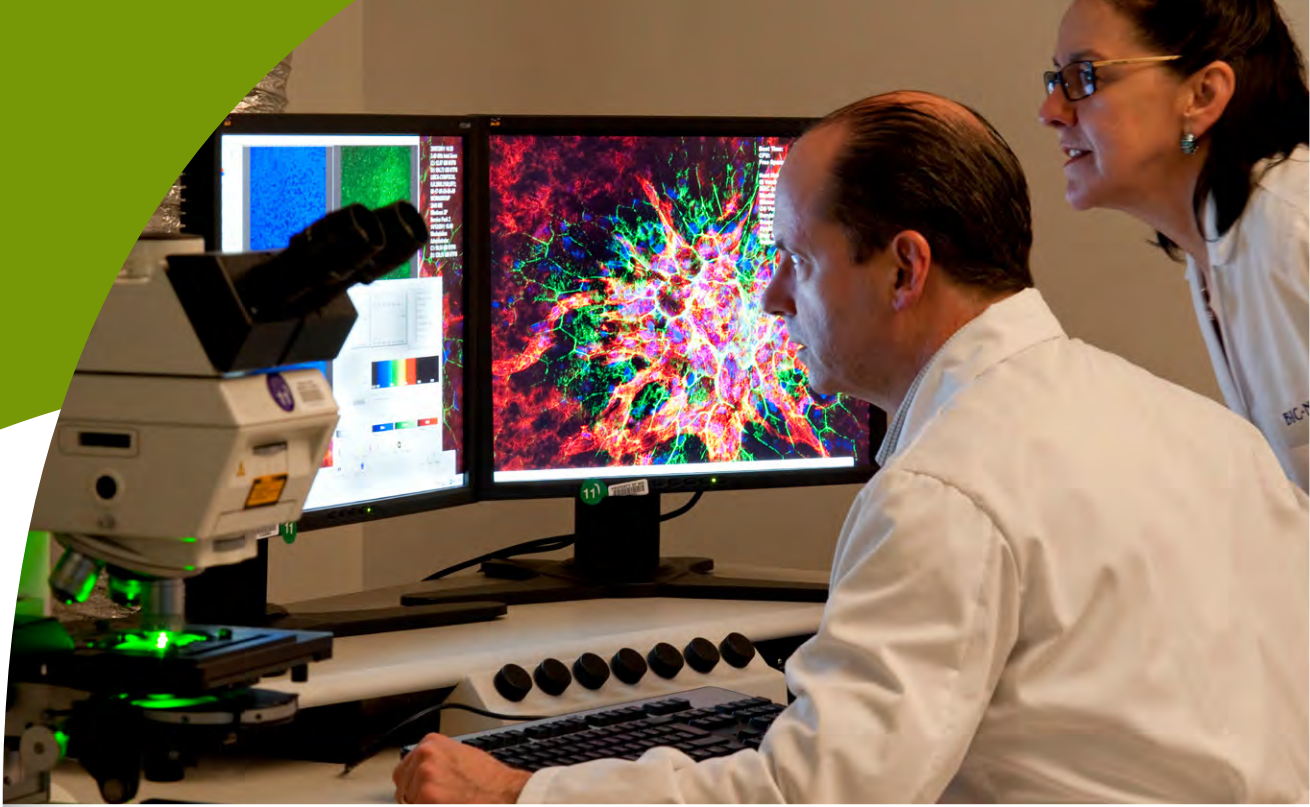
Photo Captions:

A: *Students seeking novel fish viruses with Tony Goldberg, DVM, PhD*

B: *ORIP-sponsored summer research trainee*

C: *Veterinary medical student learning techniques for research on influenza in animals*

Photo Caption:
Investigating eye tissue
samples by laser scanning
microscopy



Theme 4

Awareness of ORIP Resources and Programs

ORIP supports a wide range of resources—including animal models and related biomaterials, instrumentation and equipment, and training and career advancement—that are critical for conducting cutting-edge basic, clinical, and translational research. ORIP grants and shared resources have allowed a diverse group of investigators at large and small institutions across the United States to conduct innovative research that results in pioneering treatments and diagnostic tools. Many investigators who could benefit from ORIP programs, however, are unfamiliar with these resources. Other investigators might know about ORIP programs but need more information about how to access them. Increased awareness and dissemination of ORIP resources will accelerate efforts across the biomedical research enterprise to enhance human health and reduce illness, while increasing the return on investment of NIH research funding.

ORIP is committed to raising awareness of and improving access to its valuable resources within the NIH and across the research community. To support the dissemination of those resources, ORIP will continue productive collaborations and engage in new efforts with NIH ICOs, other federal agencies, and the broader research community. ORIP will raise awareness of its programs through meetings and workshops involving trans-NIH communities and will increase the biomedical research community's familiarity with available programs and services through social media, the ORIP website, and other communication channels.

Strategy 4.1: Foster collaborative research opportunities between ORIP-supported resources and NIH ICOs and other federal agencies.

ORIP supports research infrastructure and research-related resource programs to advance biomedical research supported by all NIH ICOs. ORIP works closely with its NIH colleagues and other federal partners to assess and enhance research infrastructure and resources to advance biomedical discoveries.

ORIP-supported animal resource centers and instrumentation programs serve thousands of investigators at research institutions across the United States, many of whom receive primary funding from NIH ICOs



Photo Caption:
Trans-NIH focus group



Safeguarding Valuable Genetic Stock Collections

ORIP partners with the U.S. Department of Agriculture (USDA) to safeguard the valuable genetic stock collections of ORIP-supported repositories at the National Laboratory for Genetic Resources Preservation in Fort Collins, Colorado.

➤ [Full story on the ORIP webpage](#)



Photo Caption:

Double mutant (*absolute*) and wild-type zebrafish (*Danio rerio*)

New approaches and technologies for creating and assessing animal models are needed to ensure and enhance the rigor and reproducibility of these valuable research resources.

and other federal agencies. Fostering new and expanding existing collaborations would help raise awareness, promote use, and increase the cost-effectiveness of ORIP-supported resources. To foster collaborations across NIH and other federal agencies in a strategic manner and to optimize potential return on scientific investment, ORIP will—

- **Increase awareness and impact of ORIP's programs** within NIH communities through innovative workshops, conferences, and similar efforts.
- **Conduct outreach to NIH program staff** regarding the benefits of ORIP-supported resources for their portfolios and solicit support for investment in ORIP's programs.
- **Engage with NIH ICOs** to identify, establish, and provide research resources that address trans-NIH needs.
- **Engage with ORIP-supported research resource centers** to cultivate opportunities to improve the efficiency and quality of those centers.

Strategy 4.2: Expand outreach to the biomedical research community to raise awareness and dissemination of ORIP-supported resources and programs.

ORIP fosters open dialogues with its grantees, other members of the biomedical research community, scientific and professional societies, and other stakeholders regarding ORIP resources and programs through workshops, conferences, meetings, site visits, and government publications. ORIP also issues regular programmatic updates to these constituents and seeks feedback from them. In addition, ORIP communicates with grantees and their institutional officials regarding the goals, outcomes, and impact of its programs and conveys the benefits of NIH investment in research resources to these stakeholders, policymakers, and the public.

ORIP's outreach to grantees and other users of supported resources helps them understand the importance of ORIP programs and their relevance to research that advances human health. The relationships formed through these outreach efforts have been vital to the improvement and dissemination of ORIP resources, as well as to raising awareness of the importance of these resources to research that has improved human health. To increase outreach to and collaboration with the biomedical research community and the public, ORIP will—

- **Connect with the biomedical research community** through such outreach activities as workshops, resource directors' meetings, requests for information (RFIs), social media, and the ORIP website.
- **Strengthen the marketing and outreach of ORIP's SBIR/STTR programs.**
- **Raise awareness of ORIP's Shared Instrumentation Program**, promote the shared use of awarded instruments, and expand the user pool through outreach to the biomedical research community.
- **Promote the successes and scientific accomplishments of ORIP programs** to the public and the biomedical research community, emphasizing the importance of these accomplishments for advancing human health.

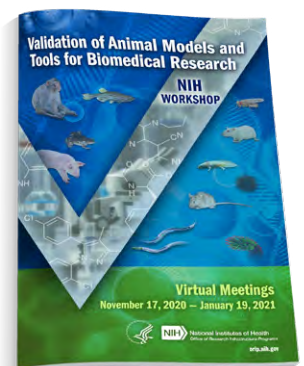
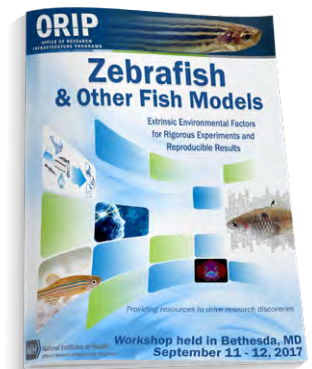


Photo Caption:
ORIP workshop publications



Photo Caption:

Placing cryopreserved animal germplasm samples into storage

Scientific Stewardship

ORIP is responsible for stewardship of taxpayer investments in the programs and resources it supports to meet the evolving needs of the biomedical research community. ORIP strives to continually improve and increase access to these resources to help drive science forward and respond to the priorities outlined in the NIH-wide strategic plan while meeting budgetary requirements. Effective management of ORIP-supported programs is essential to achieving these goals.

Continued effective support and management of research infrastructure and associated research resource and training programs will require that ORIP build and sustain effective relationships with NIH ICOs, including other Offices within DPCPSI, and other federal research agencies. ORIP also will collaborate with the biomedical research community, including users of ORIP-funded infrastructure and resources, to ensure the alignment of ORIP activities with research needs.

ORIP's relationships with stakeholders will provide opportunities to enhance existing resources, support new resources, encourage innovation, leverage existing infrastructure, recruit and develop additional expertise, retain a talented workforce, and support programmatic priorities. ORIP staff will continue to serve on trans-NIH committees and working groups and collaborate with other federal agencies to advance ORIP's strategic mission and priorities, as well as those of NIH and the wider research community.

Effective engagement of stakeholders will require ongoing communication regarding the goals, outcomes, and impacts of ORIP's support for research infrastructure and resources. ORIP will communicate with NIH ICOs and scientific societies on topics of mutual interest related to its programs. ORIP also will communicate the benefits of ongoing investment in its programs to ensure that stakeholders in the research community, policymakers, and the public maintain a thorough understanding of the fundamental importance of these programs to continued scientific progress.

Ongoing collaboration and communication with other NIH and federal entities, as well as with the biomedical research community and other stakeholders, will allow ORIP to remain current with regard to biomedical science and technological innovations as it assesses research needs, identifies gaps in infrastructure, and sets priorities for developing and delivering resources. ORIP will seek stakeholders' input with respect to research gaps and opportunities at its meetings and workshops, in its RFIs, and through its participation in professional conferences. ORIP will rely on peer review, programmatic review, and input from the NIH Council of Councils (ORIP's advisory council) and NIH program staff to monitor, evaluate, and prioritize ORIP resources and identify new meritorious resources and resource-oriented projects.

ORIP will regularly use the best available metrics to review and evaluate its existing research, infrastructure, and instrumentation programs—as well as animal model resources and animal care facilities—to ensure efficient program management and transparent stewardship. ORIP will

Investment in training is an important component of ORIP's stewardship activities because training supports the enduring success of NIH research programs.

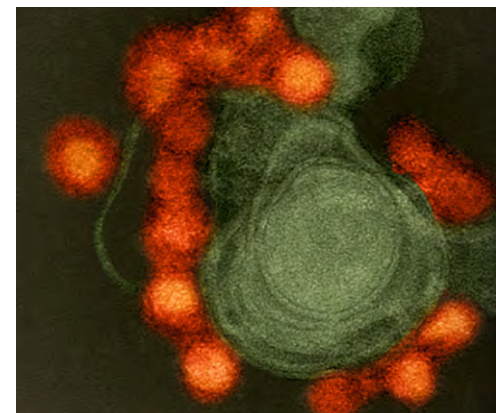


Photo Caption:
Transmission electron microscope image of Zika virus particles

ORIP will make strategic investments in methods and infrastructure tools to enhance the reproducibility of animal models and related biomaterials.



Photo Caption:
*Animal Biosafety Level 3
research on SARS-CoV-2*

measure, manage, and report on the impact of projects and programs in a rigorous, robust, and data-driven manner to continually improve its resource centers and projects and to support new, innovative research resources. ORIP will assess the contribution of its resources to improving scientific rigor and reproducibility and will make strategic investments in methods and infrastructure tools to enhance the reproducibility of animal models and related biomaterials.

As part of its ongoing priority-setting, stewardship, and management activities, ORIP will promote scientific innovation by assessing, identifying, and supporting novel and creative research resources and approaches, particularly those prioritized in the NIH-wide strategic plan (e.g., ORIP-supported Pilot Centers Program for Precision Disease Modeling). In addition to supporting trans-NIH efforts to foster innovation, ORIP will continue to support targeted initiatives to encourage paradigm-shifting research in its mission areas. For example, ORIP will continue to value and rely on Resource-Related Research Projects for Development of Animal Models and Related Materials and investigator-initiated science as critical sources of innovation. ORIP also will monitor biomedical science and technological innovations and obtain regular input from the NIH-funded research community to identify gaps and opportunities related to animal resources, as well as instrumentation and equipment support required to conduct cutting-edge research.

Although innovation is an important priority, ORIP also recognizes the importance of balancing programs that support novel research topics with programs necessary to preserve established research areas. ORIP will carefully consider the support required for ongoing work in established but important research areas, while providing the infrastructure necessary for scientists to take advantage of emerging opportunities and innovative approaches. Program officers and senior staff will periodically conduct portfolio analyses to assess program alignment with emerging and continuing high-priority research needs, as well as with new NIH initiatives.



Finally, ORIP will promote scientific innovation and ensure the enduring success of its programs through the development of a strong biomedical research workforce. Investment in training is an important component of ORIP’s stewardship activities because training supports the success of NIH research programs and contributes to NIH’s mission. ORIP will continue to support career development and training to increase the number and expertise of veterinary scientists, as well as the diversity of other investigators working with animal resources. ORIP also will seek to enhance the diversity of the health-related research workforce through its support of training in the management, use, and care of animal models and related resources. ORIP will continue to invest in students, postdoctoral researchers, and eligible investigators from groups historically underrepresented in health-related research. To assess the effectiveness of its training and career development programs, ORIP will collect the data required for long-term tracking and analysis of trainee career paths and will use these data to adjust training programs to improve outcomes and meet the needs of biomedical science. ORIP also will examine the evolving training needs of veterinary scientists and other biomedical researchers involved in the care and management of animal resources to enable rigorous research resulting in improved human health.

Photo Caption:
*Diagnostic microbial cultures
growing in an incubator*



ORIP

OFFICE OF RESEARCH
INFRASTRUCTURE PROGRAMS

Providing resources to drive research discoveries

Photo Caption:
Banner from the ORIP
webpage, orip.nih.gov

Description of ORIP Activities

Human Disease Model Resource and Research Centers and Initiatives

ORIP's comparative models program invests in the development of improved animal models that facilitate the advancement of lifesaving diagnostics, preventives, and therapies for human diseases. ORIP supports a variety of animal models traditionally used to study human disease. ORIP also supports the generation, maintenance, and distribution of new animal models to complement those traditionally used in biomedical research.

ORIP invests in resource-related research projects that develop animal-based reagents, such as antibodies, and critical genetic resources, such as microarrays and genome sequences. Additionally, ORIP supports a variety of centers that

provide animal models for human biology and disease to biomedical researchers across the United States and around the world. Depositing animals with rare and useful mutations at repositories can protect them from loss due to disease or accident and can lower the costs of maintaining them. These centers have the expertise and technical resources available to provide excellent care for these mutant animals, as well as to document their health and genetic backgrounds and ensure that their genetic makeup does not change over time. All these factors are critical to the reproducibility of preclinical studies that use these animal models.

Examples of Resource and Research Centers Supported by ORIP

Each year, several thousand researchers use ORIP-supported resource centers for biomedical research. These centers support both NIH-funded researchers and investigators funded by other governmental entities, foundations, and the private sector. Examples of some of these valuable resource and research centers are provided below.

Mutant Mouse Resource and Research Centers (MMRRCs): The [MMRRCs](#) operate repositories for the acquisition, maintenance, and distribution of mouse models, germplasm, and embryonic stem cells (ESCs) for biomedical research. Four MMRRCs and one Informatics, Coordination, and Service Center work together to preserve, protect, and ensure the quality of these models for scientists worldwide. Models available from the MMRRCs have well-defined and stable genetic backgrounds that allow investigators to generate robust and reproducible results.

The MMRRCs include more than 60,000 unique mutant alleles available in one or more forms as living mice, frozen germplasm, or ESCs. These Centers also offer the research community numerous services, such as quality control testing for mouse pathogens, mutagenesis, and ESC isolation. The MMRRCs' holdings and associated services have promoted the discovery of new diagnostics, treatments, and prevention strategies for almost every field of biomedical research.



Photo Caption:
*Three inbred mouse strains (*Mus musculus*) for research on a wide variety of diseases*

National Primate Research Centers (NPRCs): The [NPRCs](#) complement and enable the missions of other NIH ICOs by providing the NHPs, facilities, and resources required to study specific diseases, as well as expertise in all aspects of NHP biology and husbandry. The seven NPRCs facilitate approximately 1,000 research projects per year, involving investigators from all areas of biomedicine. Areas of investigation supported by the NPRCs include HIV/AIDS and other infectious diseases, metabolic and cardiovascular diseases, neurological disorders, regenerative medicine, reproductive health, medical genetics, and conditions associated with aging. Because of the extensive use of the NPRCs for HIV/AIDS research, the Office of AIDS Research (OAR) provides partial support for the NPRCs and specific-pathogen-free macaque colonies. Likewise, the National Institute on Aging (NIA) supports colonies of geriatric NHPs at select NPRCs to ensure this valuable model is available for studies on diseases of aging. Most researchers who use the NPRC physical and intellectual infrastructure are funded by the NIH Institutes and Centers (ICs) and other federal agencies.



Photo Caption:
*Specific-pathogen-free
baboon (Papio anubis)*

The NPRCs serve as a critical resource for investigating therapies and vaccines for emerging pathogens. In response to the COVID-19 pandemic, the NPRCs formed a collaborative research program to test candidate therapeutics and vaccines using NHP models. Working with NIH's [Accelerating COVID-19 Therapeutic Interventions and Vaccines \(ACTIV\) program](#), NPRC researchers developed harmonized standard operating procedures and commitment to master protocols for undertaking research studies across the seven Centers to collectively respond to the pandemic in an efficient and effective manner. Scientists also have relied upon the NPRCs to test vaccines and antivirals to protect against the Ebola virus and to generate important findings on fetal demise and loss in early pregnancy due to Zika virus infection, as well as research toward a vaccine. Therapies and vaccines for many other emerging pathogens have been investigated at the NPRCs.

National Swine Resource and Research Center (NSRRC): Supported by ORIP in partnership with the National Institute of Allergy and Infectious Diseases (NIAID) and the National Heart, Lung, and Blood

Institute (NHLBI), the [NSRRC](#) is the only national repository that assists swine-based research across multiple disciplines. The NSRRC provides invaluable services to the research community by creating at least three new genetically engineered swine models per year, as requested by investigators. The Center has facilities with top-quality biosecurity to ensure these animals remain free of defined pathogens. In addition, the NSRRC serves as a stock center by importing, maintaining, and preserving swine models and wild-type animals, cells, tissues, and organs and by distributing these critical resources to investigators throughout the country.

The Center's inventory consists of approximately 200 live animals representing more than 19 genetic backgrounds. Examples of swine models created by the NSRRC include transgenic pigs for research on organ transplantation into NHPs; immunocompromised/humanized pigs; the "oncopig" model for cancer research; and models for mammary tumors, congenital muscular dystrophy, Prader-Willi Syndrome, adenomatous polyposis coli, phenylketonuria, and Fanconi anemia group A.

Zebrafish International Research Center (ZIRC): [ZIRC](#) is a unique resource supported by ORIP in partnership with the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (NICHD) that broadly serves the national and international research communities. ZIRC is the only international repository for zebrafish genetic stocks and research materials (e.g., antibodies, cDNAs/ESTs). The Center provides resources and services to zebrafish laboratories supported by most NIH ICs.

ZIRC's overarching goal is to develop, characterize, maintain, cryopreserve, and distribute wild-type reference strains, as well as transgenic and mutant zebrafish. Using self-developed or adapted methods, ZIRC maintains more than 12,300 genetically defined lines propagated under stringent molecular quality control and health monitoring to ensure the highest level of reproducibility in research. ZIRC also provides pathology and consultation services, develops diagnostic platforms to screen for the most prevalent pathogens that are potential threats to laboratory zebrafish, and establishes standards for zebrafish



Photo Caption:
Transgenic Yucatan miniature pigs (Sus scrofa) for cardiovascular disease research

research facilities. In addition, ZIRC safeguards its resources through cryopreservation, with safe offsite backup storage at the U.S. Department of Agriculture (USDA) National Laboratory for Genetic Resources Preservation (NLGRP).

Other Aquatic Model Resources: ORIP supports a range of [aquatic model organisms](#)—such as sea slugs (*Aplysia*), clawed frogs (*Xenopus*), and axolotl salamanders (*Ambystoma*)—for use in biomedical research. These species are used in studies of human development and disease, regenerative medicine, and behavior. ORIP funds research and resource centers to develop, maintain, and preserve critical genetic stocks, biological materials, and online information for researchers using these organisms.

Bloomington Drosophila Stock Center (BDSC): ORIP supports the [BDSC](#) with co-funding support from the National Institute of Neurological Disorders and Stroke (NINDS), National Institute of General Medical Sciences (NIGMS), and NICHD. The BDSC enables the collection, maintenance, and distribution of more than 60,000 distinct and genetically characterized strains of fruit flies (*Drosophila*) used by the national and international research communities.

Drosophila are excellent animal models because they are inexpensive to maintain in the laboratory, have short lifespans, reproduce prodigiously, and have well-understood genetic characteristics. Tens of thousands of genetically distinct *Drosophila* stocks have been produced that support in-depth investigations of fundamental molecular and cellular mechanisms relevant to human health and disease.

The BDSC routinely collects transgenic or mutant strains of *Drosophila* from various projects employing gene knockout with transposable elements, gene knockdown with transgenic RNA interference, and other molecular approaches. As with other ORIP resources, BDSC scientists share available strains; their expertise on *Drosophila* genetics; and the use of Center resources, such as databases.



Photo Caption:
California sea hare (*Aplysia californica*)

Examples of ORIP Initiatives for Developing and Improving Human Disease Models

ORIP seeks to improve and disseminate the best models for human conditions and diseases that are of interest to multiple NIH ICs. The following two examples highlight ORIP's current areas of emphasis in developing animal models, making them available to researchers, and ensuring their preservation for future use.

Pilot Centers Program for Precision Disease Modeling: Affordable whole-genome sequencing and molecular profiling offer unique opportunities to study the genetics and pathogenesis of myriad human diseases. Nevertheless, genetic variation among individuals and the difficulty of interpreting this kind of information impede development of personalized therapies based on a patient's genetic makeup and molecular phenotype. To overcome these obstacles, ORIP launched the Pilot Centers Program for Precision Disease Modeling to provide the biomedical community with the advanced animal models needed to develop precision therapies for disorders controlled by a single gene, as well as diseases with more complex genetic architectures.

The first cohort of Centers under this program succeeded in developing the methods and technologies needed to rapidly model disease-specific genomic alterations in different organisms. The program now has an increased focus on creating cost-effective high-throughput pipelines for testing human genomic variants linked to diseases in such models as the mouse, rat, *Caenorhabditis elegans*, zebrafish, *Drosophila*, *Xenopus* embryos, and human-induced pluripotent stem cells. The diseases being modeled include ciliopathy; rasopathy; cohesinopathy; Marfan's syndrome; Ehlers–Danlos syndrome; macular degeneration; and musculoskeletal, cardiovascular, and neurodevelopmental defects. After validating the expected gene editing, the new Centers conduct comprehensive functional and phenotypic analyses to evaluate the disease-causing variants. The Centers also ascertain the relevance of the models to molecular, cellular, and other phenotypic characteristics



Photo Caption:
Albino African clawed frog
(*Xenopus laevis*)

observed in patients to improve understanding of disease mechanisms, develop diagnostic tools, and test targeted or repurposed therapeutics. The creation and distribution of precision animal model resources and related services continue to be core functions of the Centers.

Cryopreservation and Long-term Storage of Animal Models:

Genetically distinct lines of animal models are being generated at unprecedented rates because of rapid advancements in genetic tools, particularly gene-editing technology. This proliferation of genetic stocks poses substantial challenges for the maintenance, preservation, and sustainability of these critically needed animal models. ORIP invests in efforts devoted to embryonic and pluripotent cell biobanking and cryopreservation to support genetic stock and species preservation, genetic manipulation, strain distribution, and research in regenerative medicine. ORIP grantees are actively working on cryopreservation of embryonic and pluripotent cells from zebrafish, mice, rats, opossum, pigs, and other species.

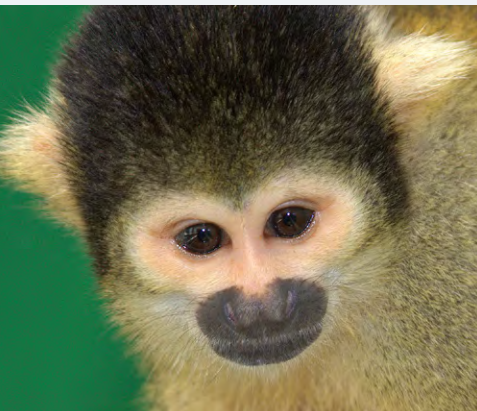


Photo Caption:
Bolivian squirrel monkey
(*Saimiri boliviensis*)

The ORIP-supported [Caenorhabditis Genetics Center](#) has archived more than 22,000 cryopreserved stocks of *C. elegans*. Additionally, sperm from more than 12,000 zebrafish lines have been cryopreserved onsite at the ORIP-supported ZIRC. Duplicates of these *C. elegans* and zebrafish samples also are cryopreserved at the USDA NLGRP. The MMRRCs, which have long been world leaders in murine cryopreservation, routinely offer investigators the services of cryopreserving mouse embryos and gametes and rederiving living mice from cryopreserved embryos and sperm. At one MMRRC, for example, funding from ORIP supported the cryopreservation of nearly 300 unique mouse strains, as well as the advancement of cryopreservation technology, including the development of a super-fecund mouse strain to reduce the costs of embryo transfer.

Compared to mammals and nematodes, long-term preservation of *Drosophila* and zebrafish has proven to be more difficult. *Drosophila* stocks still must be maintained as labor- and space-intensive live cultures, and cryopreservation in zebrafish is restricted to sperm. As a

result of two workshops organized by ORIP—the [CryoPreservation of Drosophila Strains Workshop](#) in 2016 and the [Cryopreservation of Aquatic Biomedical Models Workshop](#) in 2017—ORIP launched initiatives to develop cost-effective and reliable approaches for cryogenic and other long-term preservation and revival of wild-type and mutant strains of *Drosophila* and zebrafish. ORIP supports these initiatives with research project grants, exploratory and developmental research grants, resource-related research project grants, and SBIR/STTR grants.

Shared Instrumentation Program

ORIP's Shared Instrumentation Program provides NIH-funded teams of investigators working across a broad range of research areas access to next-generation technologies. The program supports commercially available instruments that are costly but essential to carrying out cutting-edge basic, translational, and clinical research. Examples of funded instruments include X-ray diffraction systems, nuclear magnetic resonance and mass spectrometers, DNA and protein sequencers, biosensors, electron and confocal microscopes, cell sorters, biomedical imagers, computing and informatics clusters, and high-throughput systems. Because all instruments must be used on a shared basis, they are typically installed in research core facilities. The requirement that ORIP-funded instruments be shared ensures the cost-effectiveness of instrument use, operation, and management. Applicants must demonstrate that a new instrument will help advance biomedical science, and awards are made for instruments that support at least three NIH-funded research projects.

Shared instrumentation awards advance biomedical research capacities nationwide, including institutions in under-resourced states. Over the years, the Shared Instrumentation Program has benefited the research of thousands of investigators who work at hundreds of different institutions and are funded by all NIH ICOs. The demand for new instruments has evolved over the years, reflecting advances in biomedical technologies and changes in science and research priorities. Research findings and



Photo Caption:
Instrument used for pathogen reduction and lymphocyte inactivation in blood

discoveries resulting from the use of shared instruments obtained through ORIP have supported the mission and goals of the NIH by driving biomedical research advances both nationally and internationally.

Modernization of Biomedical Research Facilities

ORIP provides funds to modernize biomedical research facilities through the acquisition and installation of equipment and alterations and renovations of existing research space. This ORIP program does not offer direct support for research activities; rather, it funds enhancements of the physical conditions of conventional and specialized biomedical research facilities. These types of modernization projects must be undertaken at an institutional animal research facility, core facility, or other shared-use space that provides access and services to many researchers, so that a sizeable local research community will draw long-term benefits from the updated operations and functions.

Investments in physical infrastructure improve or streamline operating procedures and processes in laboratories and animal research facilities. Remodeling space and providing access to efficient equipment expand the capacity of essential support services for a broad range of research programs. Refurbishing space, updating building systems, and acquiring and installing novel equipment also are essential to conducting specialized research-related activities.

Animal research facilities are an important class of infrastructure that receives ORIP modernization support. Safe and well-controlled environments and up-to-date equipment are necessary to maintain adequate stocks of healthy, well-characterized animals needed to ensure the rigor and reproducibility of experimental protocols. Renovations and modern equipment in animal facilities also help institutions comply with the Animal Welfare Act, USDA regulations, and U.S. Department of Health and Human Services policies related to the care and use of laboratory animals.

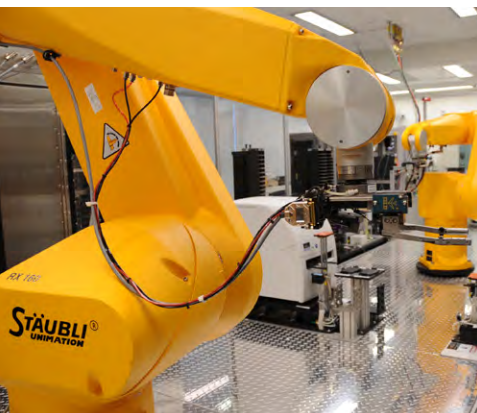


Photo Caption:
Robots for high-throughput translational research

Training and Career Development of Veterinary Scientists

Veterinary scientists play an important role in public health, particularly as a growing number of human diseases, such as COVID-19, are found at the intersection of human and animal populations in changing environments. Veterinary scientists contribute broadly to the biomedical enterprise by conducting comparative medical research, developing animal models for human diseases, and providing critical clinical expertise on interdisciplinary and translational research teams using laboratory animals.

ORIP's training programs support veterinary students' and veterinarians' participation in a variety of research experiences in laboratory animal medicine, comparative medicine, and pathology. The programs are designed to encourage talented veterinary scientists to pursue careers in biomedical research and to advance translational research by increasing the participation of veterinary scientists. These programs also provide unique training experiences for veterinary students and veterinarians that are not duplicated by NIH ICs.

One of ORIP's training programs supports institutional grants that provide summer research experiences for predoctoral veterinary students and, through multiyear support, help prepare postdoctoral veterinarians for successful careers in biomedical and translational research. ORIP also provides individual training support to predoctoral students and offers a special program for students from groups that have been shown to be underrepresented in the biomedical workforce. In addition, ORIP provides individual training grants to dual-degree students seeking a DVM (or VMD) and a PhD, as well as veterinarians seeking to add a PhD to their training.

Another ORIP training program, the [Special Emphasis Research Career Award](#) (SERCA), provides "protected time" from clinical duties to early-career veterinary scientists so they can obtain the in-depth research experience needed to excel as independent scientists. Graduates from



Photo Caption:
Training in diagnostic microbiology for veterinary medicine



New Initiatives to Reach Out to the Small Business Community

ORIP's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs reach out to individuals in communities that have been underserved by biomedical research, including those who have had fewer opportunities to participate in science as researchers or entrepreneurs.

➤ [Full story on the ORIP webpage](#)

this program have been shown to be more successful in obtaining NIH grants and publishing scientific research papers than those who did not go through the program. ORIP also funds limited-competition small research grants to bring additional research support and increased independence to SERCA recipients. This training program is the only one of its kind at the NIH that focuses on veterinary scientists.

Lastly, ORIP participates in the NIH Loan Repayment Program to recruit and retain veterinarians in NIH-mission relevant research.

Small Business Programs: Improving Methods and Technologies for Research Resources

Advancing biomedical research requires commercially available methods and technologies to improve animal models for human disease and to enhance the care and use of these crucial animal resources. The primary goal of ORIP's [small business programs](#) is to attract innovative SBIR/STTR projects that benefit research communities associated with ORIP's mission.

SBIR/STTR projects of special interest to ORIP focus on the development and commercialization of two categories of novel or emerging technologies. The first category includes technologies that contribute to the understanding, preservation, characterization, validation, and improvement of animal models for human disease. The second category of technologies supports the operations and functions of facilities engaged in the care, use, and management of laboratory animals.



Women, Minorities, and Health Disparities

ORIP advances research on women’s health, minority health, and health disparities by supporting infrastructure critical to this research through the development of animal models for human disease, access to cutting-edge instrumentation, and support of educational training programs.

ORIP also strives to increase the diversity of entrepreneurs in the research resource and infrastructure enterprise by seeking and funding SBIR/STTR applications from businesses owned by women, minorities, and socially disadvantaged persons.

ORIP’s trans-NIH activities align with the Office’s efforts to support the [2019–2023 Trans-NIH Strategic Plan for Women’s Health Research](#) and the [2020–2024 NIH Minority Health and Health Disparities Strategic Plan](#). ORIP’s programs have always included, and will continue to include, research projects that focus on sex differences in health and disease, women’s health, minority health, and health disparities across the lifespan.

Photo Caption:

Veterinary medical student learning research methods in comparative medicine

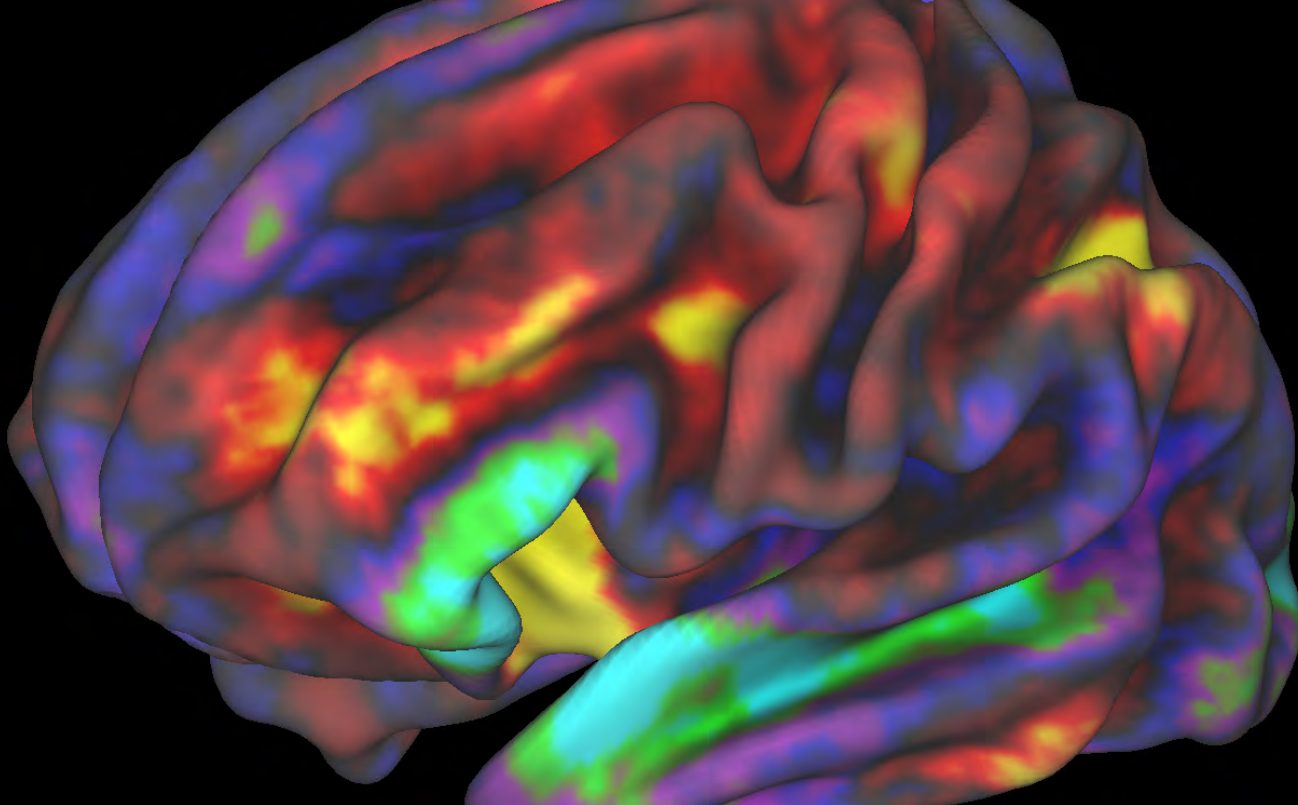


Photo Caption:

*fMRI image of a preteen brain
while the child performs a
working memory task*

ORIP's Strategic Planning Process

The ORIP 2021–2025 Strategic Plan evolved from a comprehensive consultation process that began in the fall of 2019 and entailed extensive discussions with and input from a broad spectrum of individuals, including biomedical scientists, members of professional organizations, and NIH senior program staff. Much of the Strategic Plan development process occurred during the COVID-19 health crisis, which influenced discussions and decisions regarding the development of ORIP's Themes and Strategies.

Three working groups within ORIP were responsible for the key steps involved in the process of developing the ORIP 2021–2025 Strategic Plan: (1) an RFI working group charged with soliciting input from researchers in academia and industry, scientific and professional organizations, advocacy organizations, federal agencies, and the public; (2) an NIH ICO Focus Group working group responsible for obtaining feedback from senior ICO program representatives regarding ORIP’s current programs and future directions; and (3) an Extramural Community Input working group charged with organizing webinars to seek feedback and ideas on ORIP’s scientific focus areas and potential research priorities, training and partnership opportunities, and opportunities related to emerging technologies. Throughout the entire planning process, the NIH Office of Evaluation, Performance, and Reporting was consulted in developing and refining the ORIP 2021–2025 Strategic Plan.

The development of this ORIP Strategic Plan involved the following steps:

- **In the fall of 2019**, two Council of Councils members—Dr. Terry Magnuson from The University of North Carolina at Chapel Hill and Dr. Michael Lairmore from the University of California, Davis—volunteered to serve as Council liaisons to observe and report on ORIP’s strategic planning process to the Council of Councils.
- **On December 4, 2019**, the ORIP Director announced to the NIH Extramural Program Management Committee that ORIP was seeking input for its 2021–2025 Strategic Plan and asked that senior program officials from the various ICOs participate in focus group meetings.
- **On December 13, 2019**, ORIP released NOT-OD-20-050: RFI, [FY 2021–2025 Strategic Plan for the Office of Research Infrastructure Programs: Division of Comparative Medicine and Division of Construction and Instruments Programs](#) to solicit input on the scope of ORIP programs and possible future directions to maximize the benefits of those programs for the biomedical research community.
- **On January 29 and February 11, 2020**, ORIP convened two facilitated focus group meetings with 28 representatives from 22 NIH ICOs to obtain input on infrastructure needs and opportunities for improving and increasing access to ORIP resources.

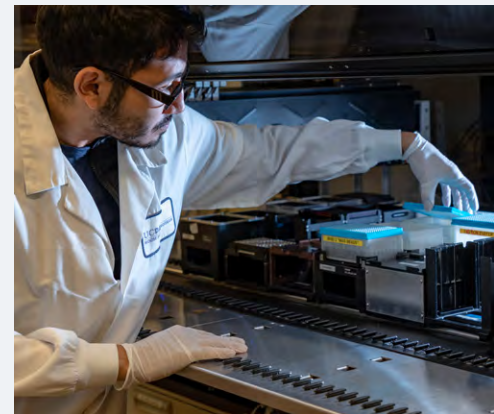


Photo Caption:
Research to create new mouse models for human diseases

- **In April and May 2020**, ORIP organized three panel discussion webinars that included 56 scientists from the biomedical research community to provide input on resource needs, challenges, opportunities, and potential new directions for ORIP. Panel members included principal investigators who manage NIH-funded animal cores or repositories, animal model experts, and basic and clinical researchers from across the United States. The webinars took place on May 5, 6, and 8, 2020.
- **From May through August 2020**, ORIP program staff worked to review and distill input from the RFI, focus group meetings, and biomedical research community webinars; this information was used to formulate a draft Strategic Plan.
- **Throughout August 2020**, ORIP leadership and staff met to articulate how the Office would continue to enhance scientific stewardship and improve management and accountability practices to ensure efficient use of taxpayer dollars.
- **In December 2020**, the draft Strategic Plan was sent to members of the Council of Councils for review and comments prior to the January 2021 Council of Councils Meeting.
- **In January 2021**, the ORIP Director presented an outline of the Strategic Plan at the NIH Council of Councils meeting.
- **In February 2021**, the NIH Director, Principal Deputy Director, and DPCPSI Director reviewed a penultimate draft of the ORIP Strategic Plan before finalization for public release.



Photo Caption:
*Rat model (Rattus norvegicus)
 for research on renal
 dysfunction, type 2 diabetes,
 and obesity*

List of Abbreviations

ACTIV	Accelerating COVID-19 Therapeutic Interventions and Vaccines
BDSC	Bloomington Drosophila Stock Center
DPCPSI	Division of Program Coordination, Planning, and Strategic Initiatives
ESC	embryonic stem cell
ICs	Institutes and Centers (at the NIH)
ICOs	Institutes, Centers, and Offices (at the NIH)
MMRRC	Mutant Mouse Resource and Research Center
NCATS	National Center for Advancing Translational Sciences
NCI	National Cancer Institute
NHLBI	National Heart, Lung, and Blood Institute
NHP	nonhuman primate
NIA	National Institute on Aging
NIAAA	National Institute on Alcohol Abuse and Alcoholism
NIAID	National Institute of Allergy and Infectious Diseases
NICHD	<i>Eunice Kennedy Shriver</i> National Institute of Child Health and Human Development
NIDDK	National Institute of Diabetes and Digestive and Kidney Diseases
NIGMS	National Institute of General Medical Sciences
NIH	National Institutes of Health
NINDS	National Institute of Neurological Disorders and Stroke
NLGRP	National Laboratory for Genetic Resources Preservation
NPRC	National Primate Research Center
NSRRC	National Swine Resource and Research Center
OAR	Office of AIDS Research
OD	Office of the Director (at the NIH)
ORIP	Office of Research Infrastructure Programs
ORWH	Office of Research on Women's Health
OSC	Office of Strategic Coordination
RFI	request for information
SBIR	Small Business Innovation Research
SERCA	Special Emphasis Research Career Award
STTR	Small Business Technology Transfer
USDA	U.S. Department of Agriculture
ZIRC	Zebrafish International Research Center

Useful ORIP Resources

Office of Research Infrastructure Programs: orip.nih.gov

Division of Comparative Medicine: orip.nih.gov/comparative-medicine

Supported Resources: orip.nih.gov/resources-directory

Vertebrate Models

Invertebrate Models

Genetic, Biological, and Information Resources

Training and Career Development:

orip.nih.gov/comparative-medicine/programs/training-and-career-development

Selected Model Resources

Bloomington Drosophila Stock Center: bdsc.indiana.edu

Mutant Mouse Resource and Research Centers: mmrrc.org

National Primate Resource Centers: nprcresearch.org

nprc.org

National Swine Resource and Research Center: nsrrc.missouri.edu

Zebrafish International Resource Center: zebrafish.org

Division of Construction and Instruments: orip.nih.gov/construction-and-instruments

Extramural Construction Programs:

orip.nih.gov/construction-and-instruments/extramural-construction-programs

The S10 Instrumentation Programs:

orip.nih.gov/construction-and-instruments/s10-instrumentation-programs

Small Business: orip.nih.gov/small-business

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Cover	Model for SARS-CoV-2, the virus that causes COVID-19	National Institute of Allergy and Infectious Diseases, NIH flickr.com/photos/nihgov/50047466123
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Inside Cover	Cryopreservation storage tank	Mutant Mouse Resource and Research Center at University of California, Davis
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